*Minia J. of Agric. Res. & Develop.*
*Vol. (36), No. 1, pp. 63-89, 2016*

FACULTY OF AGRICULTURE

# DIALLEL CROSS ANALYSIS IN EGYPTIAN COTTON FOR EARLINESS AND YIELD COMPONENT TRAITS

***S. A. Mokadem[1], A.L. Abdel-Mawgood[2], H.S. Khalifa[3] and T.M.E. Salem[3]***

[1]Agronomy Dept., Fac. of Agric., Minia University.
[2]Institute of Graduate Studies and Environmental Research, Damanhour University.
[3]Cotton Breeding Dept., Cotton Res. Inst., Agric. Res. Center, Giza, Egypt.

Received: 9 Feb. (2016) Accepted: 3 March (2016)

**ABSTRACT**

Six divergent cotton genotypes were used as parents in the present investigation. These genotypes are (Giza 85, Giza 91, C.B. 58, Karashanky, Giza 95 and (Giza 90 × Australian)). The local Egyptian cultivars are (Giza 85, Giza 91, Giza 95) and the promising hybrid (Giza 90 × Australian). The exotic varieties are (Karashanky a variety introduced from Russian and C.B. 58 a variety introduced from American). All the used genotypes belong to (Gossypium barbadense, L.). These genotypes were crossed in a half-diallel genetic design according to Griffing's method II, model I (1956). The parents, their 15 $F_1$ hybrids and 15 $F_2$ populations were evaluated. The experiments were conducted during 2013, 2014 and 2015 seasons at Sids Agric. Res. Exper. Stn., Beni-Suef Governorate, ARC, Egypt. The experiment was set as randomized complete block design with three replications. The main objectives are to determine heterosis, general and specific combining ability, gene action, broad and narrow sense heritability and inbreeding depression for earliness and yield component traits. Results indicated that the mean squares for earliness and yield and yield component traits due to parents, $F_1$ hybrids and $F_2$ generation were highly significant for all traits. Results revealed that the parent ($P_4$) was the earliest parent for (H.F.F.N.). The crosses ($P_4 \times P_5$) and ($P_4 \times P_6$) in $F_1$ were the earliest crosses as well as the cross ($P_3 \times P_4$) in $F_2$ for this trait. In addition, the parent ($P_4$) was the earliest parent for (D.F.F.). The cross ($P_4 \times P_6$) in $F_1$ and the cross ($P_4 \times P_6$) in

$F_2$ were the earliest for this trait. The parent ($P_3$) was the earliest parent for (D.F.O.B.). The cross ($P_4 \times P_6$) in $F_1$ hybrids and in $F_2$ generation was the earliest cross for this trait. Results showed that the highest mean performance was found for the parent ($P_5$) for (no.O.B. / P.). The cross ($P_4 \times P_5$) in $F_1$ as well as the cross ($P_3 \times P_6$) in $F_2$ had showed the highest mean performance for this trait. Moreover, the highest mean performance was found for the parent ($P_2$) for (B.W.). The cross ($P_2 \times P_5$) in $F_1$ and the cross ($P_1 \times P_5$) in $F_2$ showed the highest mean performance for this trait. While, the highest mean performance was found for the parent ($P_5$) for (S.C.Y.). The cross ($P_4 \times P_5$) in $F_1$ and the cross ($P_5 \times P_6$) in $F_2$ showed the highest mean performance for this trait. In addition, the highest mean performance was found for the parent ($P_5$) for (L.C.Y.). The cross ($P_4 \times P_5$) in $F_1$ and the cross ($P_4 \times P_5$) in $F_2$ showed the highest mean performance for this trait. Whereas, the highest mean performance was found for the parent ($P_5$) for (L. %). The cross ($P_1 \times P_6$) in $F_1$ as well as the cross ($P_4 \times P_5$) in $F_2$ showed the highest mean performance for this trait. Moreover, the highest mean performance was found for the parent ($P_5$) for (S.I.). The cross ($P_3 \times P_5$) in $F_1$ and the cross ($P_2 \times P_5$) in $F_2$ showed the highest mean performance for this trait. While, the highest mean performance was found for the parent ($P_5$) for (L.I.). The cross ($P_3 \times P_5$) in $F_1$ and the cross ($P_4 \times P_5$) in $F_2$ showed the highest mean performances for this trait.

**Key words:** *G. barbadense* L., Heterosis, Combining ability, Gene action, Heritability, Inbreeding depression.

## INTRODUCTION

Cotton is considered the first fiber crop in the world and it is considered the most important cash crop in Egypt, hence great effort have been devoted to increase the yield capacity and fiber quality through breeding programs, which depends on the knowledge concerning multiple factors such as heterosis, inbreeding depression and the nature of the interactions of genes controlling different characters. Cotton breeding program use hybridization between the desired genotypes and use pedigree method of selection for developing new varieties that possess higher yield and good quality.

Earliness, yield and yield components as well as fiber quality characters are important objectives in cotton breeding in Egypt. It is known that all cultivated Egyptian cotton varieties are descended from the original variety (Ashmouni) of 1860, a fact which indicates the narrow genetic base within all past breeding efforts operated. Some foreign varieties belonging to (*G. barbadense*, L.) possess a number of characteristics which, if transferred to Egyptian barbadense would be a great gain. Among of these traits are; earliness, boll weight, lint percentage and seed index. Cotton breeders have to create genetic variability in a hybridization program. At the same time, the production of promising hybrids depends on the selection of parental liens as well as their order in hybridization which yield the useful heterosis when crossed together.

Abd El-Zaher *et al.* (2009) showed that the magnitudes of dominance genetic variance were positive and larger than those of additive genetic variance for all studied traits. Khalifa (2010) showed that the mid-parent heterosis values were significantly positive and / or highly significantly positive for (B.W.), (S.C.Y. / P.), (L.Y. / P.), (L. %) and (L.I.). Khan *et al.* (2011) recorded that the mean squares due to (G.C.A.) and (S.C.A.) were highly significant for differences for days to first flowering. They also add, the mean squares due to (G.C.A.) were higher in magnitude than (S.C.A.) for majority of the earliness traits and their inheritance was mainly governed by additive type of gene action and partially by non-additive. Jenkins *et al.* (2012) showed that additive variances were larger than dominance variances for lint percentage, boll weight and lint yield. El-Kadi *et al.* (2013) showed that the heritability in broad sense ($h^2_{b.s.}$%) showed high values for all traits, indicating the low effect of environment on studied traits. Heritability in narrow sense ($h^2_{n.s.}$%) showed moderate value (30-50 %) for position of first node and high values (>50 %) for days to first flower. El-Seoudy *et al.* (2014) indicated that estimates of heritability in both broad and narrow senses for yield and its components showed high heritability values in broad sense were detected for all traits under investigation. Yehia and Hassan (2015) showed that inbreeding depression estimates were found to be positive and highly significant for all the studied traits in all studied crosses with few exceptions.

The objectives of the present work were to study heterosis, general and specific combining ability, gene action, broad and narrow sense heritability and inbreeding depression of earliness and yield component traits.

## MATERIALS AND METHODS

This investigation included six divergent cotton genotypes used as parents. These genotypes are (Giza 85, Giza 91, C.B. 58, Karashanky, Giza 95 and Giza 90 × Australian). The local Egyptian cultivars are (Giza 85, Giza 91, Giza 95) and the promising hybrid (Giza 90 × Australian). The exotic varieties are (Karashanky a variety introduced from Russian and C.B. 58 a variety introduced from American). All the used genotypes belong to (G. barbadense, L.). The pure seeds of these genotypes were obtained from Cotton Breeding Section, Cotton Research Institute, ARC.

This investigation was conducted during three seasons 2013, 2014 and 2015 at Sids Agric. Res. Exper. Stn., ARC. These six cotton genotypes were involved in a series of hybridization according to half diallel crosses mating design (Griffing, 1956) to produce $F_1$ hybrid seeds in season 2013. Fifteen $F_1$ crosses were grown in order to obtain the $F_2$ populations through self-pollination and the parental varieties were also crossed to obtain additional $F_1$ hybrid seeds in season 2014. The six parents with Fifteen $F_1$ hybrids and their corresponding $F_2$ populations were grown in season 2015. The experiment was set as a Randomized Complete Block Design with three replications. The plot size was two rows for parents and $F_1$ hybrids and six rows for $F_2$. Rows were 7.0 m long with row wide of 0.65 m and hills were spaced of 0.7 m. The experiment was planted in the 2nd April with six parent, their 15 $F_1$ hybrids and 15 $F_2$ populations. All cultural practices were followed throughout the growing season as recommended.

The measurements were recorded on five individual guarded plants from the middle of each plot for earliness traits, i.e. height of first fruiting node (H.F.F.N.), days to first flower (D.F.F.) and days to first opening boll (D.F.O.B.). While, for yield and yield component traits i.e. number of open bolls per plant (no.O.B. / P.), boll weight (B.W.) (g), seed cotton yield (S.C.Y.) (K.F.), lint cotton yield (L.C.Y.) (K.F.), lint percentage (L. %), seed index (S.I.) (g) and lint index (L.I.) (g) were taken from the whole plot.Statistical procedures used in this study were done according to the analysis of variance for a Randomized Complete Blocks Design (R.C.B.D.) as outlined by Steel and Torrie (1960).The amount of heterosis was determined as the percentage deviation of the $F_1$ hybrids over the average of the mid-parent (M.P.) or above the better-parent (B.P.). Therefore, the values of heterosis could be estimated from the following equations:

$$H\,\%\,(M.P.) = [((\overline{F}_1 - M.P.) / M.P.) \times 100]$$

$$H\,\%\,(B.P.) = [((\overline{F}_1 - B.P.) / B.P.) \times 100]$$

**Where**;

$\overline{F_1}$: is the mean of $F_1$ hybrid, M.P.: is the mean of the parents and B.P.: is the mean of the better parent.

The significance of heterosis was determined using the least significant difference value (L.S.D.) at 0.05 and 0.01 levels of probability.

Appropriate, L.S.D. values were calculated to test the significance of these effects according to the following formula:

L.S.D. for mid-parent heterosis = $t \times \sqrt{((3 \times \sigma^2 e) / (2 \times r))}$

L.S.D. for better-parent heterosis = $t \times \sqrt{((2 \times \sigma^2 e) / r)}$

**Where**;

$t_{0.05}$ and $t_{0.01}$ : tabulated values of "t" for the error degree of freedom ( $e_{df}$ ) at 0.05 and 0.01 levels of probability.

$\sigma^2 e$ : is the error variance.

r : is number of replications.

The procedures of this analysis were described by Griffing's method II, model I (1956) and outlined by Singh and Chaudhary (1985). The form of the analysis of general (G.C.A.) and specific (S.C.A.) combining ability and the expectations of mean squares are presented in Table (1).

Table (1): Form of the analysis of variance of the diallel mating design and expectations of mean squares.

| S.O.V. | D.F. | M.S. | E.M.S. |
|---|---|---|---|
| G.C.A. | P - 1 | M g | $[\sigma^2 e + \sigma^2 s + ((P + 2) \times \sigma^2 g)]$ |
| S.C.A. | [(P × (P - 1)) / 2 ] | M s | $\sigma^2 e + \sigma^2 s$ |
| Error | [(g - 1)(r - 1)] | M é | $\sigma^2 e$ |

**Where;**

p, g and r : are number of parents, genotypes and replications, respectively.

M é: is error mean square divided by number of replications.

M s and M g : are mean squares of (S.C.A.) and (G.C.A.), respectively.

In general, (G.C.A.) of a line is the average value of the line in all other combinations and it is a measure of additive genetic variance, (S.C.A.) is the ability of a line to do better or worse than the average value in a specific cross and it is a measure of non-additive genetic variances including dominance.

The mathematical model for the combining ability analysis is:

$Y_{ij} = \mu + g_i + g_j + S_{ij} + e_{ijk}$

**Where;**

$Y_{ij}$ : is the value of a cross between parents (i) and (j).

μ : is population mean.

$g_i$, $g_j$ : are the G.C.A. effects.

$S_{ij}$ : is the S.C.A. effect.

$E_{ijk}$ : is the mean error effect.

These components could be obtained through the evaluation of the diallel crosses as follows:

- S.S. due to G.C.A.: $(M_g) = [(1 / (P + 2)) \times (\sum(Y_{i.} + Y_{ii})^2 - ((4 / P) \times (Y^2 ..)))]$

- S.S. due to S.C.A.: $(M_s) = [\sum\sum Y_{ij}^2 - ((1 / (P + 2)) \times \sum (Y_{i.} + Y_{ii})^2) + ((2 / ((P + 1)(P + 2))) \times (Y^2 ..))]$

Estimation of variance components and their genetic interpretations from ANOVA Table (1), it is evident that:

$\sigma^2 gca = [(1 / (P + 2)) \times (M_g - M_s)]$, $\sigma^2 sca = M_s - M_é$ and $\sigma^2 e = M_é$

The components may be translated into genetic components using following equations:

$\sigma^2 gca = (1 / 2) \sigma^2 A$ and $\sigma^2 sca = \sigma^2 D$

In addition, the estimates of combining ability effects were determined using the following equation:

- General combining ability effects ($g_i$) for each parent:

$g_i = [(1 / (P + 2)) \times (\sum(Y_{i.} + Y_{ii}) - ((2 / P) \times (Y ..))]$

- Specific combining ability effects ($S_{ij}$) for each cross:

$S_{ij} =[Y_{ij} - ((1/ (P + 2)) \times (Y_{i.} + Y_{ii} + Y_{.j} + Y_{jj})) + ((2 / ((P + 1)(P + 2))) \times (Y ..))]$

To test the significance of general as well as specific combining abilities effects, the critical differences (C.D.) were calculated as follows:

C.D. = S.E. × t

Where;

S.E. : is standard error of effects.

t : is "t" tabulated with degree of freedom of error at 0.05 or 0.01 levels of probability.

Estimates of standard errors:

S.E. ($g_i$) = $[((P - 1) \times \sigma^2 e) / (P \times (P + 2))]^{½}$

S.E. ($s_{ij}$) = $[(P \times (P - 1) \times \sigma^2 e) / ((P + 1) (P + 2))]^{½}$

Heritability was computed in both broad sense ( $H^2_{B.S.}$ ) and narrow sense ( $H^2_{N.S.}$ ) for generations as follows:

- Heritability in broad sense:

$H^2_{B.S.}$ % = $[((2\sigma^2 gca + \sigma^2 sca) / (\sigma^2 gca + \sigma^2 sca + \sigma^2 e)) \times 100]$

Dudley and Moll (1969), Meredith (1984) and Dabholkar (1992).

- Heritability in narrow sense:

$H^2_{N.S.}$ % = $[(2\sigma^2 gca / (\sigma^2 gca + \sigma^2 sca + \sigma^2 e)) \times 100]$

Dudley and Moll (1969), Meredith (1984), Falconer (1989) and Chaudhary (1991).

Where;

$\sigma^2 e$ : is the error variance divided by the number of replications.

Inbreeding depression effect was calculated as percentage deviation of $F_2$ generation mean from $F_1$ average values as follows:

I.D. % = $[((\overline{F}_1 - \overline{F}_2) / \overline{F}_1) \times 100]$

Where:

$\overline{F_1}$ : is the mean of an $F_1$ cross.

$\overline{F_2}$ : is the mean of an $F_2$ cross.

The significance of inbreeding depression was determined using the least significant difference value (L.S.D.) at 0.05 and 0.01 levels of probability.

**RESULITS AND DISCUSSION**

Analysis of variance Table (2) revealed statistically significant differences among genotypes, parents, $F_1$ crosses and $F_2$ populations for all studied traits. Moreover means squares due to parents versus $F_1$ crosses or $F_2$ populations were highly significant except for (B.W.) and (S.I.).

Mean performances due to parents, F1 hybrids and F2 populations for earliness and yield component traits are presented in Tables (3) and (4). Results revealed that the parent (P4) was the earliest parent for (H.F.F.N.). The F1 crosses (P4 × P5) and (P4 × P6) in were the earliest crosses as well as (P3 × P4) in F2 generation. In addition, the parent (P4) was the earliest parent for (D.F.F.). The cross (P4 × P6) was the earliest in both F1 and F2. The parent (P3) was the earliest parent for (D.F.O.B.).

The cross (P4 × P6) in F1 and in F2 generation was the earliest cross for this trait. The highest mean performance was found for the parent (P5) for (no. O.B. / P.), (S.C.Y.), (L.C.Y.), (L. %), (S.I.) and (L.I.). The F1 cross (P4 × P5) showed the highest mean performance for (no.O.B. / P.), (S.C.Y.) and (L.C.Y.) traits. The F2 populations (P4 × P5) showed the highest mean performance for (L.C.Y.), (L. %) and (L.I.) traits. The F1 crosses (P2 × P5), (P1 × P6) and (P3 × P5) showed the highest mean performance for (B.W.), (L. %), (S.I.) and (L.I.). The F2 populations (P1 × P5), (P5 × P6) and (P2 × P5) showed the highest mean performance for (B.W.), (S.C.Y.) and (S.I.) traits.

Estimates of heterosis relative to the mid-parent and better parent for earliness and yield component traits are presented in Table (5). Results clarify that the crosses (P2 × P3), (P2 × P4), (P4 × P5) and (P4 × P6) had the best heterosis values for (H.F.F.N.). In addition, the crosses (P1 × P4), (P2 × P3) and (P4 × P5) had the best mid-parent heterosis values for (D.F.F.). Moreover, the crosses (P1 × P4), (P2 × P3), (P4 × P5), (P4 × P6) and (P5 × P6) had the best mid-parent heterosis values for (D.F.O.B.). Results indicated that the cross (P1 × P4) had the best heterosis values for (no.O.B. / P.), (S.C.Y.), (L.C.Y.), (L. %), and (L.I.). Moreover, the cross (P2 × P4) had the best mid-parent heterosis values for (no.O.B. / P.), (S.C.Y.), (L.C.Y.), (L. %), (S.I.) and (L.I.). In addition, the cross (P3 × P4) had the best mid-parent heterosis values for (no.O.B. / P.), (S.C.Y.), (L.C.Y.), (L. %), and (L.I.). Whereas, the cross (P3 × P6) had the best heterosis values for (B.W.), (S.C.Y.), (L.C.Y.), (L. %), and (L.I.).

These results are in agreement with those previously reported by Abd El-Zaher *et al.* (2009), Khalifa (2010), Nidagundi *et al.* (2012), El-Kadi *et al.* (2013), Nassar (2013) and Yehia and Hassan (2015).

Analysis of variance for combining ability of all parents, F1 hybrids and F2 generation for earliness and yield component traits are presented in Table (6). Mean squares of (G.C.A.) for all traits were highly significant in F1 hybrids and in F2 generation. Mean squares due to (S.C.A.) for (H.F.F.N.) was highly significant, for (D.F.F.) was insignificant and for (D.F.O.B.) was significant in F1 hybrids. In addition, mean squares due to (S.C.A.) for all traits were highly significant in F2 generation.

Mean squares of (G.C.A.) for all traits were highly significant in F1 hybrids and in F2 generation. Moreover, the analysis of variance for combining ability, mean squares of (S.C.A.) for all traits were highly significant in F1 hybrids and in F2 generation.

General combining ability effects (gi) of the parents in F1 hybrids and F2 generation for earliness and yield component traits are shown in Table (7). Generally it could be concluded that the parent (P4) was a good combiner for (H.F.F.N.), (D.F.F.) and (D.F.O.B.), as well as the parent (P6) was the best combiner for (D.F.F.) and (D.F.O.B.).

Generally it could be concluded that the parent (P1) was a good combiner for (B.W.), (S.C.Y.), (L.C.Y.), (L. %) and (L.I.), as well as the parent (P2) was the best combiner for (B.W.), (L. %) and (L.I.). So the parent (P3) was the better parent for (S.I.), as well as the parent (P4) was the best combiner for (no.O.B. / P.). The parent (P5) was good general combiner for (no.O.B. / P.), (B.W.), (S.C.Y.), (L.C.Y.), (L. %), (S.I.) and (L.I.). The parent (P6) was a good combiner for (no.O.B. / P.), (S.C.Y.) and (L.C.Y.).

These results are in agreement with those previously reported by Khan *et al.* (2011), Imran *et al.* (2012), El-Kadi *et al.* (2013), Simon *et al.* (2013), El-Seoudy *et al.* (2014), Patel *et al.* (2014), Srinivas *et al.* (2014), Usharani *et al.* (2014) and Khan *et al.* (2015).

Specific combining ability effects (sij) of F1 hybrids and F2 populations for earliness and yield component traits are shown in Table (8). Results indicated that the crosses (P1 × P6), (P2 × P3) and (P4 × P5) in F1 hybrids and the crosses (P4 × P5) and (P4 × P6) in both F1 and F2 had the best (S.C.A.) effects for (H.F.F.N.). The crosses (P1 × P3), (P1 × P5), (P1 × P6) and (P2 × P4) in F2 and the cross (P4 × P5) in both F1 and F2 had the best (S.C.A.) effects for (D.F.F.). Moreover, the crosses (P1 × P3), (P1 × P4), (P1 × P5), (P1 × P6), (P2 × P4), (P2 × P5), (P2 × P6), (P3 × P4) and (P3 × P6) in F2 and the crosses (P4 × P5) and (P4 × P6) had the best (S.C.A.) effects for (D.F.O.B.).

The results cleared that the crosses (P1 × P2) and (P1 × P4) in both F1 and F2 had the best (S.C.A.) effects for (no.O.B. / P.). The crosses (P1 × P5) and (P3 × P4) in both F1 and F2 had the best (S.C.A.) effects for (B.W.). In addition, the crosses (P1 × P2), (P1 × P4), (P2 × P4), (P3 × P4), (P3 × P5), (P3 × P6), (P4 × P5), (P4 × P6) and (P5 × P6) in both F1 and F2 had the best (S.C.A.) effects for (S.C.Y.). Moreover, the crosses (P1 × P2), (P1 × P4), (P1 × P6), (P2 × P4), (P3 × P4), (P3 × P5), (P3 × P6), (P4 × P5), (P4 × P6) and (P5 × P6) in both F1 and F2 had the best (S.C.A.) effects for (L.C.Y.). While, the crosses (P1 × P2), (P1 × P3), (P1 × P4), (P1 × P6), (P2 × P4), (P3 × P4), (P3 × P5), (P4 × P6) and (P5 × P6) in both F1 and F2 had the best (S.C.A.) effects for (L. %). The crosses (P1 × P4), (P2 × P3) and (P2 × P4) in both F1 and F2 had the best (S.C.A.) effects for (S.I.). Whereas, the crosses (P1 × P4), (P1 × P6), (P2 × P4), (P2 × P5) and (P3 × P5) in both F1 and F2 had the best (S.C.A.) effects for (L.I.).

These results are in agreement with those previously reported by Khan *et al.* Imran *et al.* (2012), (2011), El-Kadi *et al.* (2013), Simon *et al.* (2013), El-Seoudy *et al.* (2014), Patel *et al.* (2014), Srinivas *et al.* (2014), Usharani *et al.* (2014) and Khan *et al.* (2015).

Estimates of variance components for earliness and yield component traits are presented in Table (9). Results clarify that the estimates of dominance variances were higher than additive variance for all traits in both generations except (D.F.F.) trait in F1 hybrids. Results revealed that the estimates of additive variances were higher than dominance variance for (no.O.B. / P.) and (B.W.) traits in F1 hybrids. Moreover, the estimates of additive variance were higher than dominance variances for all traits except (S.C.Y.), (L. %) and (S.I.), respectively in F2 generations.

These results were in harmony with those previously reported by Abd El-Zaher *et al.* (2009), Khalifa (2010), El-Kadi *et al.* (2011), Jenkins *et al.* (2012), Saleh and Ali (2012), Nassar (2013), Deore *et al.* (2014), El-Seoudy *et al.* (2014) and Kaleri *et al.* (2015).

Estimates of heritability in broad sense (H2 B.S. %) and in narrow (H2 N.S. %) sense for earliness and yield component traits are presented in

Table (10). Results indicated that the estimated values of heritability show that broad sense heritability estimates were high for all traits in F1 hybrids and F2 generations. In addition, the estimated values of heritability show that narrow sense heritability estimates were moderate or low for most traits in F1 hybrids and F2 generations. Results showed that the estimated values of heritability show that broad sense heritability estimates were high for all traits in F1 hybrids and F2 generation.

Moreover, the estimated values of heritability show that narrow sense heritability estimates were low for most traits and moderate or high in some traits in F1 hybrids and F2 generation.

These results are in agreement with those previously reported by Abd El-Zaher *et al.* (2009), Khalifa (2010), Al-Hibbiny (2011), Abbas *et al.* (2013), El-Kadi *et al.* (2013), Gopikrishnan *et al.* (2013), Nassar (2013), Abbas *et al.* (2014), El-Seoudy *et al.* (2014) , Farooq *et al.* (2014), Ahsan *et al.* (2015), Dahiphale *et al.* (2015) and Kaleri *et al.* (2015).

Estimates of inbreeding depression (I.D. %) for earliness and yield component traits are presented in Table (11). Results cleared that the percentage of inbreeding depression of all traits had recorded highly significant or significant positively in some crosses. Results indicated that the percentage of inbreeding depression of all traits had recorded highly significant or significant positively in the most crosses.

These results are in agreement with these previously reported by Khalifa (2010), Nassar (2013), Komal *et al.* (2014) and Yehia and Hassan (2015).

Table (2):- Analysis of variance for earliness and yield component traits in $F_1$ and $F_2$ generation.

| S.O.V. | D.F. | Genotypes | H.F.F.N. | D.F.F. | D.F.O.B. | no.O.B. / P. | B.W. (g) | S.C.Y. (K.F.) | L.C.Y. (K.F.) | L. % | S.I. (g) | L.I. (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Replicat-ions | 2 | $F_1$ | 0.231 | 6.208 | 1.836 | 110.467** | 0.167** | 0.016 | 0.024 | 0.008 | 0.055 | 0.024 |
| | | $F_2$ | 0.539 | 1.099 | 1.098 | 43.265** | 0.087* | 0.005 | 0.008 | 0.003 | 0.042 | 0.020 |
| Genotypes | 20 | $F_1$ | 1.626** | 10.763** | 11.604** | 373.672** | 0.256** | 8.891** | 15.747** | 7.130** | 0.332** | 0.619** |
| | | $F_2$ | 1.738** | 12.656** | 15.547** | 291.372** | 0.234** | 3.006** | 6.004** | 8.531** | 0.646** | 0.807** |
| Parents | 5 | $F_1$ | 0.932** | 12.009** | 7.699** | 489.545** | 0.445** | 4.188** | 8.668** | 10.295** | 0.531** | 1.026** |
| | | $F_2$ | 0.932** | 12.009** | 7.699** | 489.545** | 0.445** | 4.188** | 8.668** | 10.295** | 0.531** | 1.026** |
| Crosses | 14 | $F_1$ | 1.562** | 10.228** | 10.458* | 342.705** | 0.199** | 4.358** | 7.350** | 3.832** | 0.281** | 0.344** |
| | | $F_2$ | 1.543** | 5.781* | 5.444** | 229.532** | 0.168** | 2.464** | 4.509** | 5.652** | 0.731** | 0.658** |
| Parents Vs Crosses | 1 | $F_1$ | 5.984** | 12.014* | 47.177** | 227.840** | 0.123 | 95.873** | 168.705** | 37.486** | 0.056 | 2.422** |
| | | $F_2$ | 8.505** | 112.142** | 196.226** | 166.255** | 0.099 | 4.686** | 13.611** | 40.007** | 0.036 | 1.810** |
| Error | 40 | $F_1$ | 0.149 | 2.795 | 3.393 | 16.348 | 0.031 | 0.022 | 0.031 | 0.018 | 0.056 | 0.022 |
| | | $F_2$ | 0.210 | 2.134 | 0.910 | 8.380 | 0.025 | 0.013 | 0.017 | 0.011 | 0.047 | 0.020 |

*, ** Significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Table (3):- Mean performances of the studied six parents for earliness and yield component traits.

| Genotypes | H.F.F.N. | D.F.F. | D.F.O.B. | no.O.B. / P. | B.W. (g) | S.C.Y. (K.F.) | L.C.Y. (K.F.) | L. % | S.I. (g) | L.I. (g) |
|---|---|---|---|---|---|---|---|---|---|---|
| $P_1$ | 8.40 | 76.33 | 125.46 | 47.64 | 3.27 | 6.19 | 7.32 | 37.50 | 8.98 | 5.39 |
| $P_2$ | 8.80 | 73.20 | 123.53 | 36.61 | 3.64 | 5.58 | 6.78 | 38.58 | 8.70 | 5.46 |
| $P_3$ | 8.73 | 71.86 | 121.60 | 45.40 | 2.55 | 4.96 | 5.59 | 35.78 | 9.53 | 5.31 |
| $P_4$ | 7.33 | 70.80 | 121.80 | 54.42 | 2.78 | 4.34 | 4.82 | 35.25 | 8.80 | 4.79 |
| $P_5$ | 8.03 | 72.80 | 124.86 | 70.84 | 3.03 | 7.76 | 9.77 | 39.93 | 9.71 | 6.45 |
| $P_6$ | 7.90 | 71.20 | 122.60 | 64.87 | 2.86 | 6.08 | 6.87 | 35.82 | 8.84 | 4.93 |
| Mean | 8.20 | 72.70 | 123.31 | 53.30 | 3.02 | 5.82 | 6.86 | 37.14 | 9.09 | 5.39 |
| L.S.D. 0.05 | 0.60 | 1.90 | 2.123 | 5.72 | 0.28 | 0.38 | 0.43 | 0.33 | 0.30 | 0.19 |
| L.S.D. 0.01 | 0.85 | 2.70 | 3.018 | 8.13 | 0.39 | 0.54 | 0.61 | 0.47 | 0.43 | 0.28 |

$P_1$, $P_2$, $P_3$, $P_4$, $P_5$ and $P_6$ are Giza 85, Giza 91, C.B. 58, Karashanky, Giza 95 and (Giza 90 × Australian), respectively.

Table (4): Mean performance of the respective $F_1$ and $F_2$ generations for earliness and yield component traits.

| Crosses | | H.F.F.N. | D.F.F. | D.F.O.B. | no.O.B. / P. | B.W. (g) | S.C.Y. (K.F.) | L.C.Y. (K.F.) | L. % | S.I. (g) | L.I. (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_1 \times P_2$ | $F_1$ | 8.133 | 72.733 | 122.333 | 52.853 | 3.288 | 7.943 | 9.831 | 39.288 | 9.067 | 5.867 |
| | $F_2$ | 7.867 | 71.133 | 120.533 | 44.088 | 3.365 | 6.542 | 8.221 | 39.897 | 8.517 | 5.653 |
| $P_1 \times P_3$ | $F_1$ | 8.233 | 72.600 | 121.733 | 48.843 | 2.977 | 7.346 | 9.008 | 38.925 | 9.603 | 6.12 |
| | $F_2$ | 7.733 | 69.267 | 119.267 | 47.755 | 3.021 | 5.796 | 7.091 | 38.839 | 8.740 | 5.55 |
| $P_1 \times P_4$ | $F_1$ | 7.433 | 70.467 | 120.333 | 75.58 | 2.892 | 8.807 | 10.743 | 38.725 | 9.3200 | 5.89 |
| | $F_2$ | 7.067 | 69.400 | 118.867 | 57.632 | 2.821 | 7.035 | 8.626 | 38.929 | 9.093 | 5.797 |
| $P_1 \times P_5$ | $F_1$ | 8.500 | 74.667 | 124.733 | 53.316 | 3.541 | 10.248 | 12.538 | 38.84 | 8.923 | 5.667 |
| | $F_2$ | 7.667 | 70.200 | 119.800 | 45.835 | 3.381 | 7.054 | 8.823 | 39.707 | 9.173 | 6.041 |
| $P_1 \times P_6$ | $F_1$ | 7.600 | 73.067 | 122.600 | 53.768 | 3.256 | 8.856 | 11.242 | 40.300 | 9.283 | 6.266 |
| | $F_2$ | 7.467 | 69.267 | 118.800 | 48.073 | 3.084 | 6.665 | 8.377 | 39.902 | 8.487 | 5.635 |
| $P_2 \times P_3$ | $F_1$ | 7.600 | 69.933 | 119.600 | 44.671 | 2.948 | 6.321 | 7.190 | 36.109 | 9.523 | 5.382 |
| | $F_2$ | 8.000 | 70.200 | 120.200 | 39.428 | 3.310 | 4.273 | 5.094 | 37.847 | 9.443 | 5.751 |
| $P_2 \times P_4$ | $F_1$ | 6.467 | 69.667 | 120.200 | 57.069 | 3.153 | 8.028 | 9.753 | 38.567 | 9.397 | 5.899 |
| | $F_2$ | 6.467 | 68.067 | 117.733 | 41.630 | 3.281 | 6.016 | 7.272 | 38.379 | 9.777 | 6.089 |
| $P_2 \times P_5$ | $F_1$ | 8.067 | 74.267 | 123.867 | 41.689 | 3.614 | 7.491 | 9.490 | 40.215 | 9.207 | 6.193 |
| | $F_2$ | 7.867 | 70.667 | 120.133 | 48.005 | 3.265 | 6.699 | 8.293 | 39.303 | 10.033 | 6.497 |
| $P_2 \times P_6$ | $F_1$ | 7.467 | 72.667 | 122.400 | 51.332 | 3.259 | 7.144 | 8.480 | 37.685 | 8.863 | 5.361 |
| | $F_2$ | 7.733 | 69.467 | 119.267 | 41.443 | 3.317 | 5.048 | 6.312 | 39.699 | 8.857 | 5.831 |
| $P_3 \times P_4$ | $F_1$ | 6.933 | 70.733 | 120.467 | 64.519 | 2.969 | 8.879 | 10.735 | 38.381 | 9.21 | 5.737 |
| | $F_2$ | 6.067 | 68.533 | 118.200 | 39.856 | 3.336 | 5.657 | 6.674 | 37.452 | 8.563 | 5.128 |

Table 4, (Continued)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_3 \times P_5$ | $F_1$ | 7.800 | 74.000 | 123.533 | 57.844 | 3.242 | 9.112 | 11.410 | 39.752 | 9.687 | 6.391 |
| | $F_2$ | 8.000 | 73.267 | 122.867 | 54.125 | 3.007 | 6.951 | 8.626 | 39.395 | 9.557 | 6.212 |
| $P_3 \times P_6$ | $F_1$ | 7.467 | 71.733 | 121.133 | 53.049 | 3.229 | 9.002 | 11.186 | 39.449 | 8.78 | 5.72 |
| | $F_2$ | 7.800 | 69.267 | 119.067 | 71.142 | 2.574 | 6.696 | 7.527 | 35.686 | 8.993 | 4.99 |
| $P_4 \times P_5$ | $F_1$ | 6.333 | 69.333 | 118.867 | 80.662 | 2.779 | 10.707 | 12.672 | 37.573 | 8.76 | 5.272 |
| | $F_2$ | 6.600 | 68.733 | 118.333 | 53.125 | 3.087 | 7.417 | 9.668 | 41.384 | 9.26 | 6.538 |
| $P_4 \times P_6$ | $F_1$ | 6.333 | 69.133 | 118.200 | 65.708 | 2.723 | 8.519 | 10.428 | 38.858 | 8.81 | 5.599 |
| | $F_2$ | 6.200 | 67.800 | 117.533 | 53.119 | 3.007 | 7.064 | 8.344 | 37.499 | 8.467 | 5.08 |
| $P_5 \times P_6$ | $F_1$ | 8.400 | 71.000 | 120.933 | 61.813 | 2.995 | 9.914 | 12.543 | 40.167 | 9.000 | 6.042 |
| | $F_2$ | 8.267 | 70.933 | 120.467 | 60.378 | 2.861 | 7.504 | 9.399 | 39.763 | 8.687 | 5.734 |
| Mean | $F_1$ | 7.518 | 71.733 | 121.396 | 57.514 | 3.124 | 8.555 | 10.483 | 38.856 | 9.162 | 5.827 |
| | $F_2$ | 7.387 | 69.747 | 119.404 | 49.709 | 3.114 | 6.428 | 7.890 | 38.912 | 9.043 | 5.768 |
| L.S.D. 0.05 | $F_1$ | 0.661 | 3.083 | 3.422 | 7.319 | 0.296 | 0.204 | 0.262 | 0.192 | 0.444 | 0.274 |
| | $F_2$ | 0.830 | 2.718 | 1.510 | 4.352 | 0.265 | 0.080 | 0.106 | 0.087 | 0.387 | 0.248 |
| L.S.D. 0.01 | $F_1$ | 0.890 | 4.150 | 4.607 | 9.854 | 0.398 | 0.274 | 0.353 | 0.258 | 0.597 | 0.368 |
| | $F_2$ | 1.118 | 3.659 | 2.033 | 5.859 | 0.356 | 0.108 | 0.143 | 0.117 | 0.521 | 0.335 |

$P_1$, $P_2$, $P_3$, $P_4$, $P_5$ and $P_6$ are Giza 85, Giza 91, C.B. 58, Karashanky, Giza 95 and (Giza 90 × Australian), respectively.

Table (5): Estimates of heterosis (H.%) relative to the mid-parent (M.P.) and better parent (B.P.) for earliness and yield component traits.

| Crosses | H. % | H.F.F.N. | D.F.F. | D.F.O.B. | no.O.B. / P. | B.W. (g) | S.C.Y. (K.F.) | L.C.Y. (K.F.) | L. % | S.I. (g) | L.I. (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_1 \times P_2$ | M.P. | -5.426 | -2.72 | -1.74 | 25.448** | -4.898 | 34.817** | 39.335** | 3.270** | 2.506 | 8.039** |
| | B.P. | -3.175 | -0.638 | -0.971 | 10.923 | -9.664* | 28.147** | 34.268** | 1.815** | 0.89 | 7.289** |
| $P_1 \times P_3$ | M.P. | -3.891 | -2.024 | -1.457 | 4.973 | 2.087 | 31.656** | 39.503** | 6.232** | 3.707* | 14.353** |
| | B.P. | -1.984 | 1.020 | 0.110 | 2.506 | -9.103* | 18.516** | 23.028** | 3.799** | 0.734 | 13.495** |
| $P_1 \times P_4$ | M.P. | -5.508 | -4.213* | -2.669* | 48.082** | -4.567 | 67.103** | 76.939** | 6.452** | 4.797* | 15.670** |
| | B.P. | 1.364 | -0.471 | -1.204 | 38.858** | -11.681* | 42.082** | 46.736** | 3.264** | 3.709 | 9.226** |
| $P_1 \times P_5$ | M.P. | 3.448 | 0.134 | -0.346 | -10.012* | 12.185** | 46.770** | 46.719** | 0.314 | -4.546* | -4.346* |
| | B.P. | 5.809 | 2.564 | -0.107 | -24.745** | 8.139 | 31.955** | 28.334** | -2.744** | -8.101** | -12.224** |
| $P_1 \times P_6$ | M.P. | -6.748 | -0.949 | -1.156 | -4.435 | 6.109 | 44.147** | 58.427** | 9.914** | 4.131* | 21.314** |
| | B.P. | -3.797 | 2.622 | 0.000 | -17.124** | -0.570 | 42.872** | 53.551** | 7.465** | 3.301 | 16.195** |
| $P_2 \times P_3$ | M.P. | -13.307** | -3.584* | -2.420* | 8.923 | -4.852 | 19.867** | 16.138** | -2.892** | 4.441* | -0.146 |
| | B.P. | -12.977** | -2.69 | -1.645 | -1.625 | -19.005** | 13.171** | 5.901** | -6.422** | -0.105 | -1.577 |
| $P_2 \times P_4$ | M.P. | -19.834** | -3.241 | -2.011 | 25.367** | -1.884 | 61.739** | 68.002** | 4.457** | 7.370** | 14.995** |
| | B.P. | -11.818** | -1.601 | -1.314 | 4.850 | -13.382** | 43.742** | 43.662** | -0.054 | 6.780** | 7.879** |
| $P_2 \times P_5$ | M.P. | -4.158 | 1.735 | -0.268 | -22.412** | 8.233* | 12.216** | 14.620** | 2.429** | 0.000 | 3.868* |
| | B.P. | 0.415 | 2.015 | 0.270 | -41.158** | -0.703 | -3.541* | -2.865 | 0.700* | -5.183* | -4.075* |
| $P_2 \times P_6$ | M.P. | -10.578** | 0.646 | -0.542 | 1.154 | 0.238 | 22.382** | 24.159** | 1.282** | 1.026 | 3.032 |
| | B.P. | -5.485 | 2.060 | -0.163 | -20.879** | -10.462* | 17.320** | 23.421** | -2.338** | 0.226 | -1.970 |
| $P_3 \times P_4$ | M.P. | -13.692** | -0.841 | -1.013 | 29.245** | 11.131* | 90.872** | 106.156** | 8.060** | 0.473 | 13.556** |
| | B.P. | -5.455 | -0.094 | -0.932 | 18.536** | 6.551 | 78.965** | 91.958** | 7.263** | -3.392 | 7.998** |
| $P_3 \times P_5$ | M.P. | -6.958* | 2.304 | 0.243 | -0.49 | 15.867** | 43.183** | 48.548** | 5.000** | 0.676 | 8.6206** |
| | B.P. | -2.905 | 2.968 | 1.590 | -18.354** | 6.683 | 17.325** | 16.787** | -0.460 | -0.240 | -1.005 |

Table 5 (Continue)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_3 \times P_6$ | M.P. | -10.220** | 0.28 | -0.792 | -3.8 | 19.163** | 62.926** | 79.503** | 10.175** | -4.444* | 11.617** |
| | B.P. | -5.485 | 0.749 | -0.384 | -18.234** | 12.799* | 47.839** | 62.802** | 10.103** | -7.902** | 7.686** |
| $P_4 \times P_5$ | M.P. | -17.570** | -3.435* | -3.621** | 28.773** | -4.573 | 76.840** | 73.685** | -0.057 | -5.348** | -6.260** |
| | B.P. | -13.636** | -2.072 | -2.408 | 13.851** | -8.530 | 37.856** | 29.703** | -5.914** | -9.783** | -18.342** |
| $P_4 \times P_6$ | M.P. | -16.849** | -2.629 | -3.273** | 10.148* | -3.588 | 63.342** | 78.364** | 9.332** | -0.132 | 15.092** |
| | B.P. | -13.636** | -2.354 | -2.955* | 1.278 | -4.867 | 39.914** | 51.770** | 8.455** | -0.377 | 13.393** |
| $P_5 \times P_6$ | M.P. | 5.439 | -1.389 | -2.262* | -8.916* | 1.514 | 43.098** | 50.751** | 6.030** | -2.982 | 6.055** |
| | B.P. | 6.329 | -0.281 | -1.359 | -12.753** | -1.426 | 27.644** | 28.384** | 0.578* | -7.312** | -6.416** |
| L.S.D. 0.05 | M.P. | 0.551 | 2.388 | 2.631 | 5.775 | 0.250 | 0.211 | 0.253 | 0.190 | 0.339 | 0.21 |
| | B.P. | 0.636 | 2.757 | 3.038 | 6.669 | 0.289 | 0.243 | 0.292 | 0.220 | 0.392 | 0.243 |
| L.S.D. 0.01 | M.P. | 0.736 | 3.192 | 3.517 | 7.719 | 0.334 | 0.281 | 0.338 | 0.255 | 0.453 | 0.281 |
| | B.P. | 0.850 | 3.686 | 4.061 | 8.913 | 0.386 | 0.325 | 0.391 | 0.294 | 0.524 | 0.325 |

$P_1$, $P_2$, $P_3$, $P_4$, $P_5$ and $P_6$ are Giza 85, Giza 91, C.B. 58, Karashanky, Giza 95 and (Giza 90 × Australian), respectively.

*, ** Significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Table (6):- Analysis of variance for combining ability for earliness and yield component traits in $F_1$ and $F_2$ generation.

| S.O.V. | D.F. | Genotypes | H.F.F.N. | D.F.F. | D.F.O.B. | no.O.B. / P. | B.W. (g) | S.C.Y. (K.F.) | L.C.Y. (K.F.) | L. % | S.I. (g) | L.I. (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G.C.A. | 5 | $F_1$ | 1.189** | 9.090** | 7.961** | 311.274** | 0.217** | 3.295** | 6.155** | 3.076** | 0.202** | 0.298** |
| | | $F_2$ | 1.250** | 5.420** | 4.528** | 240.824** | 0.203** | 2.481** | 5.217** | 6.103** | 0.403** | 0.747** |
| S.C.A. | 15 | $F_1$ | 0.326** | 1.753 | 2.503* | 62.318** | 0.041** | 2.853** | 4.947** | 2.143** | 0.080** | 0.175** |
| | | $F_2$ | 0.355** | 3.818** | 5.400** | 49.224** | 0.036** | 0.509** | 0.929** | 1.757** | 0.152** | 0.109** |
| Error | 40 | $F_1$ | 0.050 | 0.932 | 1.131 | 5.450 | 0.010 | 0.007 | 0.010 | 0.006 | 0.019 | 0.007 |
| | | $F_2$ | 0.070 | 0.711 | 0.303 | 2.790 | 0.008 | 0.004 | 0.006 | 0.004 | 0.016 | 0.007 |

*, ** Significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Table (7):- General combining ability effects (g $_i$) of six parents in $F_1$ and $F_2$ generation for earliness and yield component traits.

| Genotypes | | H.F.F.N. | D.F.F. | D.F.O.B. | no.O.B. / P. | B.W. (g) | S.C.Y. (K.F.) | L.C.Y. (K.F.) | L. % | S.I. (g) | L.I. (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_1$ | $F_1$ | 0.338** | 1.516** | 1.133** | -1.815* | 0.103** | 0.147** | 0.233** | 0.312** | 0.021 | 0.084** |
| | $F_2$ | 0.158 | 0.975** | 0.5694** | -2.059** | 0.074* | 0.212** | 0.326** | 0.427** | -0.178** | -0.021 |
| $P_2$ | $F_1$ | 0.168* | 0.200 | 0.233 | -9.167** | 0.233** | -0.790** | -0.977** | 0.058* | -0.068 | -0.035 |
| | $F_2$ | 0.275** | 0.225 | 0.161 | -8.416** | 0.274** | -0.504** | -0.549** | 0.430** | 0.078 | 0.141** |
| $P_3$ | $F_1$ | 0.188* | -0.167 | -0.492 | -4.304** | -0.149** | -0.479** | -0.678** | -0.549** | 0.233** | 0.007 |
| | $F_2$ | 0.216* | 0.017 | -0.106 | -1.503** | -0.158** | -0.561** | -0.871** | -1.009** | 0.119** | -0.171** |
| $P_4$ | $F_1$ | -0.727** | -1.641** | -1.491** | 7.276** | -0.198** | -0.099** | -0.270** | -0.745** | -0.113* | -0.242** |
| | $F_2$ | -0.783** | -1.249** | -1.172** | -0.117 | -0.065* | -0.239** | -0.367** | -0.588** | -0.081 | -0.176** |
| $P_5$ | $F_1$ | 0.147* | 0.600 | 1.008** | 5.354** | 0.071* | 1.073** | 1.506** | 0.980** | 0.124** | 0.319** |
| | $F_2$ | 0.142 | 0.658* | 0.961** | 6.001** | 0.007 | 0.921** | 1.397** | 1.321** | 0.340** | 0.538** |
| $P_6$ | $F_1$ | -0.115 | -0.508 | -0.392 | 2.655** | -0.061 | 0.148** | 0.185** | -0.057* | -0.197** | -0.132** |
| | $F_2$ | -0.008 | -0.624* | -0.413* | 6.094** | -0.132** | 0.170** | 0.066** | -0.581** | -0.278** | -0.310** |
| S.E. ( g $_i$ ) | $F_1$ | 0.072 | 0.312 | 0.343 | 0.753 | 0.033 | 0.027 | 0.033 | 0.025 | 0.044 | 0.027 |
| | $F_2$ | 0.085 | 0.272 | 0.178 | 0.539 | 0.029 | 0.021 | 0.024 | 0.019 | 0.04 | 0.026 |

$P_1$, $P_2$, $P_3$, $P_4$, $P_5$ and $P_6$ are Giza 85, Giza 91, C.B. 58, Karashanky, Giza 95 and (Giza 90 × Australian), respectively.

*, ** Significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Table (8):- Specific combining ability effects ($s_{ij}$) for earliness and yield component traits in $F_1$ and $F_2$ generations.

| Crosses | | H.F.F.N. | D.F.F. | D.F.O.B. | no.O.B. / P. | B.W. (g) | S.C.Y. (K.F.) | L.C.Y. (K.F.) | L. % | S.I. (g) | L.I. (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_1 \times P_2$ | $F_1$ | -0.086 | -0.993 | -0.976 | 7.524** | -0.145 | 0.812** | 1.125** | 0.549** | -0.03 | 0.115 |
| | $F_2$ | -0.186 | -0.657 | -0.718 | 3.827** | -0.073 | 0.578** | 0.849** | 0.630** | -0.441** | -0.128* |
| $P_1 \times P_3$ | $F_1$ | -0.007 | -0.76 | -0.851 | -1.349 | -0.074 | -0.096 | 0.004 | 0.793** | 0.205* | 0.326** |
| | $F_2$ | -0.261 | -2.315** | -1.717** | 0.582 | 0.015 | -0.110* | 0.041 | 1.013** | -0.259** | 0.082 |
| $P_1 \times P_4$ | $F_1$ | 0.110 | -1.418 | -1.251 | 13.806** | -0.11 | 0.984** | 1.332** | 0.789** | 0.269* | 0.345** |
| | $F_2$ | 0.073 | -0.915 | -1.051* | 9.071** | -0.277** | 0.805** | 1.071** | 0.681** | 0.294** | 0.332** |
| $P_1 \times P_5$ | $F_1$ | 0.301 | 0.540 | 0.649 | -6.534** | 0.269** | 1.253** | 1.349** | -0.821** | -0.365** | -0.439** |
| | $F_2$ | -0.252 | -2.023** | -2.251** | -8.843** | 0.210** | -0.335** | -0.496** | -0.449** | -0.047 | -0.137* |
| $P_1 \times P_6$ | $F_1$ | -0.336* | 0.049 | -0.085 | -3.383 | 0.117 | 0.785** | 1.375** | 1.676** | 0.316** | 0.611** |
| | $F_2$ | -0.302 | -1.673** | -1.876** | -6.698** | 0.052 | 0.026 | 0.388** | 1.648** | -0.115 | 0.304** |
| $P_2 \times P_3$ | $F_1$ | -0.469** | -2.109** | -2.084* | 1.832 | -0.232** | -0.183** | -0.603** | -1.767** | 0.214* | -0.292** |
| | $F_2$ | -0.111 | -0.632 | -0.376 | -1.388 | 0.105 | -0.916** | -1.080** | 0.017 | 0.187* | 0.119* |
| $P_2 \times P_4$ | $F_1$ | -0.686** | -0.901 | -0.485 | 2.648 | 0.021 | 1.143** | 1.552** | 0.885** | 0.434** | 0.474** |
| | $F_2$ | -0.644** | -1.498* | -1.776** | -0.573 | -0.018 | 0.504** | 0.594** | 0.128** | 0.721** | 0.463** |
| $P_2 \times P_5$ | $F_1$ | 0.039 | 1.457* | 0.682 | -10.810** | 0.212** | -0.565** | -0.488** | 0.808** | 0.007 | 0.205** |
| | $F_2$ | -0.169 | -0.807 | -1.509** | -0.316 | -0.105 | 0.027 | -0.149** | -0.856** | 0.556** | 0.156* |
| $P_2 \times P_6$ | $F_1$ | -0.299 | 0.965 | 0.615 | 1.532 | -0.010 | 0.011 | -0.176* | -0.683** | -0.015 | -0.174** |
| | $F_2$ | -0.152 | -0.724 | -1.001* | -6.971** | 0.086 | -0.873** | -0.799** | 1.441** | -0.001 | 0.338** |
| $P_3 \times P_4$ | $F_1$ | -0.240 | 0.532 | 0.507 | 5.234** | 0.220** | 1.683** | 2.235** | 1.307** | -0.053 | 0.269** |
| | $F_2$ | -0.985** | -0.824 | -1.042* | -9.259** | 0.469** | 0.202** | 0.317** | 0.641** | -0.533** | -0.185** |
| $P_3 \times P_5$ | $F_1$ | -0.249 | 1.557* | 1.074 | 0.482 | 0.22** | 0.744** | 1.133** | 0.952** | 0.186 | 0.362** |
| | $F_2$ | 0.023 | 2.001** | 1.490** | -1.109 | 0.069 | 0.335** | 0.504** | 0.675** | 0.039 | 0.184** |

Table 8 (Continue)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_3 \times P_6$ | $F_1$ | -0.320 | 0.399 | 0.074 | -1.614 | 0.343** | 1.558** | 2.230** | 1.687** | -0.399** | 0.142* |
| | $F_2$ | -0.027 | -0.715 | -0.934* | 15.814** | -0.225** | 0.830** | 0.736** | -1.131** | 0.095 | -0.188** |
| $P_4 \times P_5$ | $F_1$ | -0.798** | -1.634* | -2.592** | 11.718** | -0.190* | 1.958** | 1.987** | -1.029** | -0.394** | -0.507** |
| | $F_2$ | -0.377 | -1.265* | -1.976** | -3.496** | 0.056 | 0.479** | 1.042** | 2.242** | -0.058 | 0.514** |
| $P_4 \times P_6$ | $F_1$ | -0.536** | -0.726 | -1.859* | -0.536 | -0.114 | 0.695** | 1.064** | 1.293** | -0.023 | 0.270** |
| | $F_2$ | -0.627** | -0.915 | -1.401** | -3.595** | 0.115 | 0.876** | 1.049** | 0.260** | -0.231* | -0.094 |
| $P_5 \times P_6$ | $F_1$ | 0.655** | -1.101 | -1.626* | -2.51 | -0.112 | 0.917** | 1.402** | 0.875** | -0.07 | 0.151* |
| | $F_2$ | 0.514* | 0.31 | -0.601 | -2.454 | -0.103 | 0.156** | 0.339** | 0.615** | -0.432** | -0.154* |
| S.E. ( $_{ij}$ ) | $F_1$ | 0.163 | 0.706 | 0.778 | 1.709 | 0.074 | 0.062 | 0.075 | 0.056 | 0.100 | 0.062 |
| | $F_2$ | 0.194 | 0.617 | 0.403 | 1.223 | 0.066 | 0.048 | 0.055 | 0.044 | 0.092 | 0.059 |

$P_1$, $P_2$, $P_3$, $P_4$, $P_5$ and $P_6$ are Giza 85, Giza 91, C.B. 58, Karashanky, Giza 95 and (Giza 90 × Australian), respectively.

*, ** Significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Table (9):- Genetic variance components for earliness and yield component traits in $F_1$ and $F_2$ generations.

| Component | Crosses | H.F.F.N. | D.F.F. | D.F.O.B. | no.O.B. / P. | B.W. (g) | S.C.Y. (K.F.) | L.C.Y. (K.F.) | L. % | S.I. (g) | L.I. (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $\sigma^2_{G.C.A.}$ | $F_1$ | 0.108 | 0.917 | 0.682 | 31.12 | 0.022 | 0.055 | 0.151 | 0.117 | 0.015 | 0.015 |
| | $F_2$ | 0.112 | 0.2 | -0.109 | 23.95 | 0.021 | 0.246 | 0.536 | 0.543 | 0.031 | 0.08 |
| $\sigma^2_{S.C.A.}$ | $F_1$ | 0.277 | 0.822 | 1.373 | 56.869 | 0.032 | 2.846 | 4.937 | 2.138 | 0.061 | 0.168 |
| | $F_2$ | 0.286 | 3.107 | 5.097 | 46.431 | 0.028 | 0.505 | 0.924 | 1.754 | 0.137 | 0.103 |
| $\sigma^2 e$ | $F_1$ | 0.050 | 0.932 | 1.131 | 5.449 | 0.010 | 0.007 | 0.010 | 0.006 | 0.019 | 0.007 |
| | $F_2$ | 0.070 | 0.711 | 0.303 | 2.793 | 0.008 | 0.004 | 0.006 | 0.004 | 0.016 | 0.007 |
| $\sigma^2_{G.C.A} / \sigma^2_{S.C.A.}$ | $F_1$ | 0.390 | 1.116 | 0.497 | 0.547 | 0.692 | 0.019 | 0.031 | 0.055 | 0.249 | 0.092 |
| | $F_2$ | 0.391 | 0.064 | -0.021 | 0.516 | 0.744 | 0.488 | 0.580 | 0.31 | 0.228 | 0.771 |
| $\sigma^2 A$ | $F_1$ | 0.216 | 1.834 | 1.364 | 62.239 | 0.044 | 0.111 | 0.302 | 0.233 | 0.031 | 0.031 |
| | $F_2$ | 0.224 | 0.401 | -0.218 | 47.900 | 0.042 | 0.493 | 1.072 | 1.086 | 0.063 | 0.159 |
| $\sigma^2 D$ | $F_1$ | 0.277 | 0.822 | 1.373 | 56.869 | 0.032 | 2.846 | 4.937 | 2.138 | 0.061 | 0.168 |
| | $F_2$ | 0.286 | 3.107 | 5.097 | 46.431 | 0.028 | 0.505 | 0.924 | 1.754 | 0.137 | 0.103 |

Table (10):- Estimates of heritability in broad and narrow sense for earliness and yield components traits in $F_1$ and $F_2$ generations.

| $H^2$ % | Crosses | H.F.F.N. | D.F.F. | D.F.O.B. | no.O.B. / P. | B.W. (g) | S.C.Y. (K.F.) | L.C.Y. (K.F.) | L. % | S.I. (g) | L.I. (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $H^2_{B.S.}$ % | $F_1$ | 90.861 | 74.032 | 70.762 | 95.625 | 88.074 | 99.756 | 99.801 | 99.751 | 83.043 | 96.492 |
| | $F_2$ | 87.908 | 83.141 | 94.144 | 97.124 | 89.521 | 99.568 | 99.716 | 99.873 | 92.737 | 97.56 |
| $H^2_{N.S.}$ % | $F_1$ | 39.810 | 51.126 | 35.273 | 49.968 | 51.138 | 3.732 | 5.756 | 9.815 | 27.622 | 14.938 |
| | $F_2$ | 38.580 | 9.498 | 0.000 | 49.318 | 53.528 | 49.192 | 53.564 | 38.203 | 29.051 | 59.168 |

From previous results can be used as hybrids earliest and highly yielding in cotton breeding programs to improve the Upper Egypt cotton.

Table (11):- Inbreeding depression (I.D.%) for earliness and yield component traits.

| Crosses | H.F.F.N. | D.F.F. | D.F.O.B. | no.O.B. / P. | B.W. (g) | S.C.Y. (K.F.) | L.C.Y. (K.F.) | L. % | S.I. (g) | L.I. (g) |
|---|---|---|---|---|---|---|---|---|---|---|
| $P_1 \times P_2$ | 3.279 | 2.2 | 1.471 | 16.584* | -2.36 | 17.645** | 16.369** | -1.549** | 6.066** | 3.645 |
| $P_1 \times P_3$ | 6.073 | 4.591* | 2.026 | 2.227 | -1.478 | 21.099** | 21.272** | 0.22 | 8.989** | 9.314** |
| $P_1 \times P_4$ | 4.933 | 1.514 | 1.219 | 23.746** | 2.448 | 20.126** | 19.706** | -0.527** | 2.432 | 1.589 |
| $P_1 \times P_5$ | 9.803* | 5.982** | 3.955** | 14.032* | 4.526 | 31.169** | 29.631** | -2.233** | -2.802 | -6.605** |
| $P_1 \times P_6$ | 1.754 | 5.200** | 3.099* | 10.592 | 5.278 | 24.746** | 25.489** | 0.986** | 8.581** | 10.072** |
| $P_2 \times P_3$ | -5.263 | -0.381 | -0.502 | 11.738 | -12.275* | 32.405** | 29.152** | -4.811** | 0.840 | -6.843** |
| $P_2 \times P_4$ | 0.000 | 2.297 | 2.052 | 27.053** | -4.06 | 25.072** | 25.437** | 0.486** | -4.043 | -3.218 |
| $P_2 \times P_5$ | 2.479 | 4.847* | 3.013* | -15.152 | 9.655* | 10.580** | 12.609** | 2.268** | -8.979** | -4.907* |
| $P_2 \times P_6$ | -3.571 | 4.403* | 2.559* | 19.265** | -1.78 | 29.339** | 25.563** | -5.343** | 0.075 | -8.766** |
| $P_3 \times P_4$ | 12.500** | 3.11 | 1.881 | 38.225** | -12.345* | 36.285** | 37.826** | 2.419** | 7.021** | 10.614** |
| $P_3 \times P_5$ | -2.564 | 0.991 | 0.54 | 6.430 | 7.243 | 23.713** | 24.399** | 0.897** | 1.342 | 2.800 |
| $P_3 \times P_6$ | -4.464 | 3.438 | 1.706 | -34.106** | 20.291** | 25.618** | 32.712** | 9.537** | -2.43 | 12.760** |
| $P_4 \times P_5$ | -4.211 | 0.865 | 0.449 | 34.139** | -11.057* | 30.729** | 23.705** | -10.140** | -5.707* | -24.009** |
| $P_4 \times P_6$ | 2.105 | 1.929 | 0.564 | 19.159** | -10.414 | 17.086** | 19.986** | 3.498** | 3.897 | 9.271** |
| $P_5 \times P_6$ | 1.587 | 0.094 | 0.386 | 2.321 | 4.483 | 24.308** | 25.069** | 1.005** | 3.481 | 5.090* |
| L.S.D. 0.05 | 0.636 | 2.757 | 3.038 | 6.669 | 0.289 | 0.243 | 0.292 | 0.220 | 0.392 | 0.243 |
| L.S.D. 0.01 | 0.850 | 3.686 | 4.061 | 8.913 | 0.386 | 0.325 | 0.391 | 0.294 | 0.524 | 0.325 |

$P_1$, $P_2$, $P_3$, $P_4$, $P_5$ and $P_6$ are Giza 85, Giza 91, C.B. 58, Karashanky, Giza 95 and (Giza 90 × Australian), respectively.

*, ** Significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

**REFERENCES**

Abbas H.G.; Mahmood A. and Ali Q. (2013). Genetic variability, heritability, genetic advance and correlation studies in cotton (Gossypium hirsutum, L.). IRJM., 4(6):156-161.

Abbas, H.G.; Mahmood A.; Ali Q.; Saif-ul-Malook; Waseem M. and Khan N. H. (2014). Genetic variability for yield, its components and quality traits in upland cotton (Gossypium hirsutum, L.). Nature and Science, 12(11):31-35.

Abd El-Zaher, G.H.; Khalifa, H.S. and Abd El-Gelil, H.M. (2009). Diallel analysis in some interspecific cotton crosses for yield components and fiber traits. J. Agric. Sci. Mansoura Univ., 34(4):2565-2575.

Ahsan, M.Z.; Majidano, M.S.; Bhutto, H.; Soomro, A.W.; Panhwar, F.H.; Channa, A.R. and Sial, K.B. (2015). Genetic Variability, Coefficient of Variance, Heritability and Genetic Advance of Some (Gossypium hirsutum, L.) Accessions. Journal of Agricultural Science, 7(2):147-151.

Al-Hibbiny, Y.I.M. (2011). Breeding of Some Boll Characters and its Contents in Cotton. Ph.D. Thesis, Agron. Fac. Agric., Tanta Univ., Egypt. 198.

Allard, R.W. (1960). Principles of Plant Breeding. John Wiley and Sons Inc., New York, London.

El-Kadi, D.A.; El-Deeb, A.A.; El-Shaarawy S.A. and Abd El-Fattah, H.M. (2011). Triallel analysis for yield and some fiber quality characters in Egyptian cotton. Egypt. J. Plant Breed., 15(3):213-230.

El-Kadi, D.A.; El-Feki, T.A.; Koronfel, M.A. and Mohamed, A.A. (2013). Biometrical analysis of a diallel cross of Egyptian cotton comprising seven parents. Egypt. J. Plant Breed., 17(5):41-56.

El-Seoudy, A.A.; Abdel-Ghaffar, N.Y.; Awad, H.Y.; Abdel-Hady, A. and Darweesh S.I.M. (2014). Evaluation of some crosses for economic traits in cotton (Gossypium barbadense, L.). Egypt. J. Agric. Res., 92(1):183-193.

Dabholkar, A.R. (1992). Elements of Biometrical Genetics. Concept Publ. Camp., New Delhi, India.

Dahiphale, K.D.; Deshmukh, J.D.; Jadhav, A.B. and Bagade, A.B. (2015). Genetic Variability, correlation and path coefficient analysis for yield and its attributing traits in cotton (Gossypium hirsutum, L.). International Journal of Tropical Agriculture., 33(1):15-22.

Deore, G.N.; Shinde, G.C. and Mehetre, S.S. (2014). Genetic

Analysis of Some Quantitative Traits in Trihybrid Cross of (Gossypium species.). Cotton Res. J., 5(2):142-149.

Dudley, J.W. and Moll, R.H. (1969). Interpretation and use of estimates of heritability and genetic variance in plant breeding. Crop Sci., 9:257-262.

Chaudhary, R.C. (1991). Introduction to Plant Breeding. pp 261. Oxford and IBH Publishing Co. PVT. LD. New Delhi-Bombay.

Falconer, D.S. (1989). Introduction to Quantitative Genetics. Second edition, pp 438. Longman, New York, USA.

Farooq, J.; Anwar, M.; Riaz, M.; Farooq, A.; Mahmood, A.; Shahid, M. T. H., M. Rafiq S. and Ilahi, F. (2014). Correlation and path coefficient analysis of earliness, fiber quality and yield contributing traits in cotton (Gossypium hirsutum, L.). J. Anim. Plant Sci., 24(3):781-790

Griffing, B. (1956). Concept of general and specific combining ability in relation to diallel crossing system. Aust. J. Biol. Sci., 9:463-493.

Gopikrishnan, P.; Shunmugavalli, N. and Anand, G. (2013). Genetic variabilty studies in interspecific cotton (Gossypium spp) hybrids. Electronic Journal of Plant Breeding, 4(3):1251-1254.

Imran, M.; Shakeel, A.; Azhar, F.M.; Farooq, J.; Saleem, M.F.; Saeed, A.; Nazeer, W.; Riaz, M.; Naeem, M. and Javaid, A. (2012). Combining ability analysis for within-boll yield components in upland cotton (Gossypium hirsutum, L.). Genet. Mol. Res., 11(3):2790-2800.

Jenkins, J.N.; McCarty Jr., J.C.; Wu, J.; Hayes, R. and Stelly, D. (2012). Genetic effects of nine (Gossypium barbadense, L.). chromosome substitution lines in top crosses with five elite Upland cotton (*G. hirsutum*, L.). cultivars. Euphytica, 187:161-173.

Kaleri, F.N.; Rashid, M.A.R.; Soomro, Z.A.; Channa, S.A. and Mari S. (2015). Diallel analysis for lint yield per plant, lint index and staple length in upland cotton. Am-Euras. J. Agric. & Environ. Sci., 15(3):332-338.

Khalifa, H.S. (2010). Genetic studies on earliness, yield components and fiber properties of two Egyptian cotton crosses. Egypt. J. Plant Breed., 14(3):143-156.

Khan, S.A.; Naqib, U.K.; Fida, M.; Mushtaq, A.; Ijaz, A.K.; Zarina, B. and Imidad Ullah, K. (2011). Combining ability analysis in intraspecific $F_1$ diallel cross of upland cotton. Pak. J. Bot., 43(3):1719-1723.

Khan, S.A.; Khan, N.U.; Gul, R.; Bibi, Z.; Khan, I.U.; Gul, S.; Ali, S. and Baloch, M. (2015). Combining ability studies for yield and fiber traits in upland cotton. J. Anim. Plant Sci., 25(3):698-707.

Komal P., Madariya R. B., Raiyani G. D. and Lata Raval. (2014). Assessment of heterosis and inbreeding depression in cotton (Gossypium hirsutum, L.). International Quarterly journal of life sciences (Supplement on Genetics and Plant Breeding)., 9(4): 1853-1856.

Meredith, W.R. Jr. (1984). Quantitative inheritance. In: R.J. Kohel and C.F. Lewis (Eds.), Cotton. Agronomic Monographs pp 131-150. ASA, CSSA, SSSA, South Segoe, Madison, WI. USA.

Nassar, M.A.A. (2013). Some Genetic Parameters and Heterosis in Two Crosses of Egyptian cotton. J. Appl. Sci. Res., 9(1):548-553.

Nidagundi, J. M.; Patil, S.S.; Salimath, P.M.; Kajjidoni, S.T.; Patil, B.C. and Hegde, M.G. (2012). Heterobeltiosis in multiple environments for seed cotton yield and yield attributes in cotton (Gossypium hirsutum, L.). Karnataka J. Agric. Sci., 25(3):301-304.

Patel, D.H.; Patel, D.U. and Kumar, V. (2014). Heterosis and combining ability analysis in tetraploid cotton (G. hirsutum, L. and G. barbadense, L.). Electronic Journal of Plant Breeding, 5(3):408-414.

Saleh, E.M.R.M. and Ali, S.E. (2012). Diallel analysis for yield components and fiber traits in cotton. Egypt. J. Plant Breed., 16(2):65-77.

Simon, S.Y.; Kadams, A.M. and Aliyu, B. (2013). Combining ability analysis in $F_1$ hybrids of Cotton (Gossypium Species.). by diallel method in northeastern Nigeria. Greener J. of Agric. Sci. Nigeria, 3(2):090-096.

Singh, R.K. and Chaudhary, B.D. (1985). Biometrical Methods in Quantitative Genetic Analysis. Kalyani publishers, New Delhi.

Steel, R.G.D. and Torrie, J.H. (1960). Principles and Procedures of Statistics.Second Edition, McGraw Hill Book Company Inc., New York.

Srinivas, B.; Bhadru, D.; Rao, M.V.B. and Gopinath, M. (2014). Combining ability studies for yield and fibre quality traits in upland cotton (Gossypium hirsutum, L.). SABRAO J. Breed. Genet., 46(2):313-318.

Usharani, K.S.; Vindhiyavarman, P. and Balu, P.A. (2014). Combining ability analysis in intraspecific $F_1$ diallel cross of upland cotton (Gossypium hirsutum L.). Electronic Journal of Plant Breeding, 5(3):467-474.

Yehia, W.M.B. and Hassan, S.S. (2015). Genetic analysis of yield and its components of some Egyptian cotton crosses (Gossypium barbadense, L.). Egypt. J. Plant Breed., 19(4):999-1010.

## الملخص العربي

# التحليل التبادلى فى بعض التراكيب الوراثية للقطن المصرى لصفة التبكير والنضج ومكونات المحصول

**شكرى عبد السلام مقدم[1] ، أحمد لطفى عبد الموجود[2] ، حسين صلاح خليفة[3] و طاهر محمد السيد سالم[3]**

[1] قسم المحاصيل – كلية الزراعة – جامعة المنيا.

[2] معهد الدراسات العليا والبحوث البيئية – جامعة دمنهور.

[3] قسم تربية القطن – معهد بحوث القطن – مركز البحوث الزراعية – الجيزة – مصر.

شملت الدراسة الحالية ستة تراكيب وراثية مختلفة من القطن استخدمت كآباء. هذه التراكيب الوراثية هي (جيزة 85، جيزة 91، C.B. 58، كاراشنكى، جيزة 95 و(جيزة 90 × استرالي)). الأصناف المصرية المحلية هى (جيزة 85، جيزة 91، جيزة 95) والهجين المتميز (جيزة 90 × استرالي). الأصناف المستوردة هي (كاراشنكى صنف مستورد من روسيا وC.B. 58 صنف مستورد من أمريكا). جميع التراكيب الوراثية المستخدمة تنتمي إلى (Gossypium barbadense, L.). وقد تم تهجين هذه التراكيب الوراثية فى لتصميم التهجين النصف تبادلى وفقا لـ (Griffing, 1956)، النموذج الاول، الطريقة الثانية لستة آباء وانسالهم 15 هجين للجيل الاول و 15عشيرة للجيل الثانى.

أجريت التجريبية خلال مواسم 2013 ، 2014 و 2015 في محطة البحوث الزراعية بسدس بمحافظة بني سويف، التابعة لمركز البحوث الزراعية بجمهورية مصر العربية . تم تنفيذ التجربة بتصميم القطاعات كاملة العشوائية بثلاثة مكررات.وكانت الاهداف الرئيسية من الدراسة الحالية هى تحديد قوة الهجين ، القدرة العامة والخاصة على التآلف، طبيعة فعل الجين، درجة التوريث والتقدم الوراثي المتوقع من الانتخاب و التربية الداخلية لصفة التبكير والمحصول ومكونات المحصول. ومن اهم نتائج الدراسة الحالية ما يلى:

– أشارت النتائج إلى أن تباينات صفات التبكير المدروسة للآباء وهجن الجيل الاول والثانى كانت عالية المعنوية لجميع الصفات ما عدا صفة تاريخ تفتح اول زهرة كانت معنوية في الجيل الثانى. كما أظهرت النتائج أن تباينات صفات المحصول ومكوناته المدروسة للآباء وهجن الجيل الاول والثانى كانت عالية المعنوية لجميع الصفات.

– أظهرت النتائج أن الاب ($P_4$) وكذلك الهجن ($P_4 \times P_5$) و ($P_4 \times P_6$) فى الجيل الاول وايضا الهجين ($P_3 \times P_4$) في الجيل الثانى كانوا الاكثر تبكيرا لصفة ارتفاع عقد اول فرع ثمرى. بالإضافة إلى ذلك، كان الاب ($P_4$) وكذلك الهجين ($P_4 \times P_6$) فى الجيل الاول والثانى كانوا الاكثر تبكيرا لصفة تاريخ تفتح اول زهرة. الاب ($P_3$) والهجين ($P_4 \times P_6$) كانوا الاكثر تبكيرا لصفة تاريخ تشقق اول لوزة.

– أوضحت النتائج أن أعلى متوسط أداء كان للاب ($P_5$) والهجين ($P_4 \times P_5$) فى الجيل الاول والهجين ( $P_3 \times P_6$) في الجيل الثانى لصفة عدد اللوز المتفتح على النبات. وعلاوة على ذلك، كان أعلى متوسط أداء لصفة متوسط وزن اللوزة للاب ($P_2$) وقد أظهر كلا من الهجين ($P_2 \times P_5$) فى الجيل الاول والهجين ( $P_1 \times P_5$) في الجيل الثانى أعلى متوسط أداء لهذه الصفة. في حين، الاب ($P_5$) والهجين ($P_4 \times P_5$) فى الجيل الاول والهجين ($P_5 \times P_6$) في الجيل الثانى قد أظهروا أعلى متوسط أداء لصفة محصول القطن الزهر. وبالإضافة إلى ذلك، وجد أعلى متوسط أداء بالنسبة لصفة محصول القطن الشعر كان للاب ($P_5$) والهجين ($P_4 \times P_5$) فى الجيل الاول والثانى. في حين كان أعلى متوسط أداء بالنسبة لصفة تصافى الحليج للاب ($P_5$) وقد أظهر الهجين ($P_1 \times P_6$) فى الجيل الاول وكذلك الهجين ($P_4 \times P_5$) في الجيل الثانى أعلى متوسط أداء لهذه الصفة. وعلاوة على ذلك، كان أعلى متوسط أداء بالنسبة لصفة معامل البذرة أظهره كلا من للاب ($P_5$) وكذلك الهجين ($P_3 \times P_5$) فى الجيل الاول وايضا الهجين ($P_2 \times P_5$) في الجيل الثانى. في حين، أظهر الاب ($P_5$) أعلى أداء متوسط بالنسبة لصفة معامل الشعر وقد أظهر ايضا الهجين ($P_3 \times P_5$) فى الجيل الاول وكذلك الهجين ($P_4 \times P_5$) في الجيل الثانى أعلى متوسط أداء لهذه الصفة.

من النتائج السابقة يمكن استخدام الهجن المبكرة والعالية المحصول فى برامج تربية القطن لتحسين اقطان الوجه القبلى.